

Wintershall Production Optimisation Initiative Value Creation through Innovation



■ - BASF Group



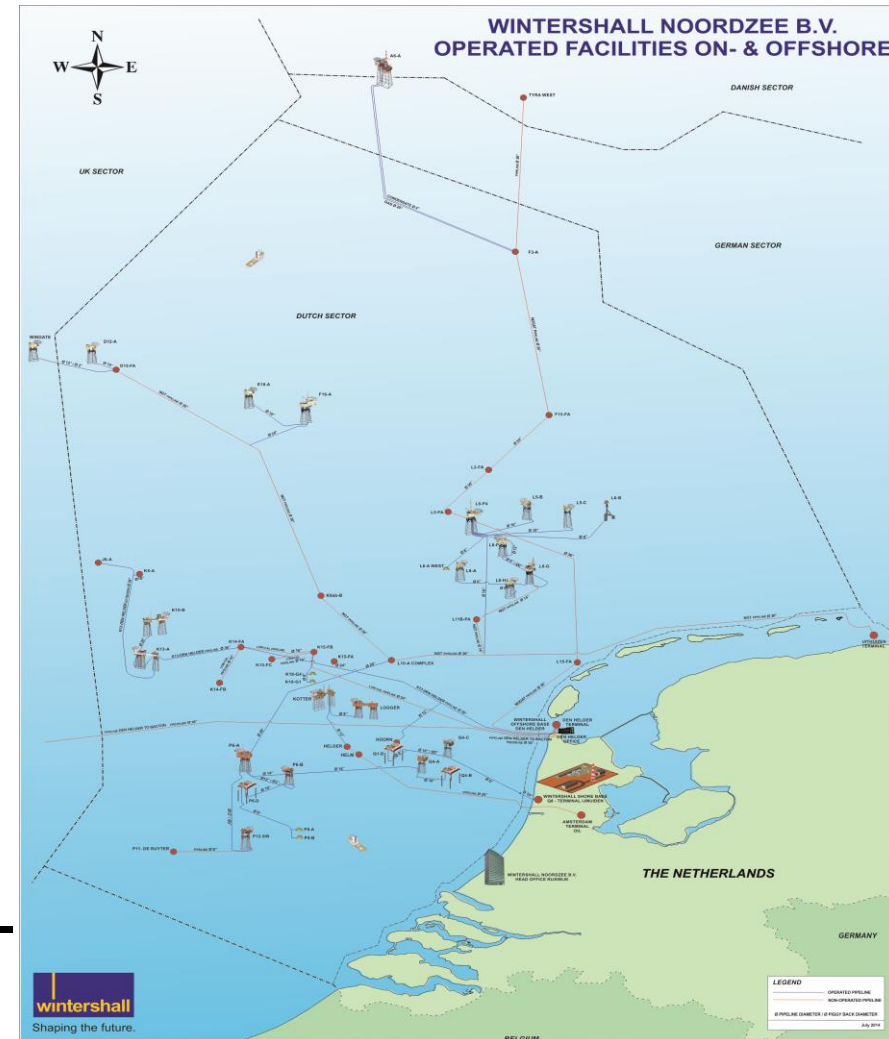
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Wintershall Noordzee BV

Wintershall Noordzee B.V. (WINZ)



- **Subsidiary of Wintershall Holding**
- **Operator in NL, Germany, DK, UK**
- **Personnel of 550**
- **Offshore operated**
 - 22 gas & 2 oil platforms
 - 5 Subsea gas wells
 - 700 km pipelines
- **Onshore**
 - Remote control room
 - Process/compression terminal
- **Portfolio includes full value chain - exploration to abandonment**



Production Optimisation Initiative

■ WINZ situation 2010

- WINZ focus historically mainly on exploration & development activities
- Optimisation of the company's producing assets was insufficient
- Production halved between 2007 and 2010
- End of field life on a significant number of assets approaching rapidly
- A high degree of urgency existed to remedy this situation

■ Objectives of initiative

- Maximise field-life asset value of existing WINZ fields
 - Increase production and reserves
 - Reduce costs
 - Extend economic field life
 - Safeguard assets against potential future threats

Applied Methodology – “Toolbox”



1. Re-organisation
2. Technical excellence
3. Integration
4. Technology
5. Commercial
6. Vision

1. Re-organisation

■ Objectives

- Achieve step-change in performance through transformation
- Separate Production Optimisation & Development – dedicated effort
- Sharpen focus of entire WINZ organisation on producing assets
- Improve technical competency of staff and promote integrated approach

■ Results

- Re-organisation successfully implemented
- Key projects implemented within relatively short timeframe
- Technical level and integration improved
- New recruitment strategy - 14 reservoir/production eng. hired in tight market
- Technology department introduced
 - value add through innovation
 - pro-active value protection

1. Re-organisation



WINZ Production Optimisation
One Team - One Course - One Goal

1. Re-organisation

■ Challenges

- Low degree of change readiness of organisation
- Priority on projects vs softer factors due to urgency
- Initial high workload
 - Insufficient experienced staff for new challenges
 - Attrition of staff due to re-organisation
- Under estimating complexity of re-organisation

2. Tech. Excellence – Carboniferous Gas

■ Complex Carboniferous gas field off-shore Netherlands

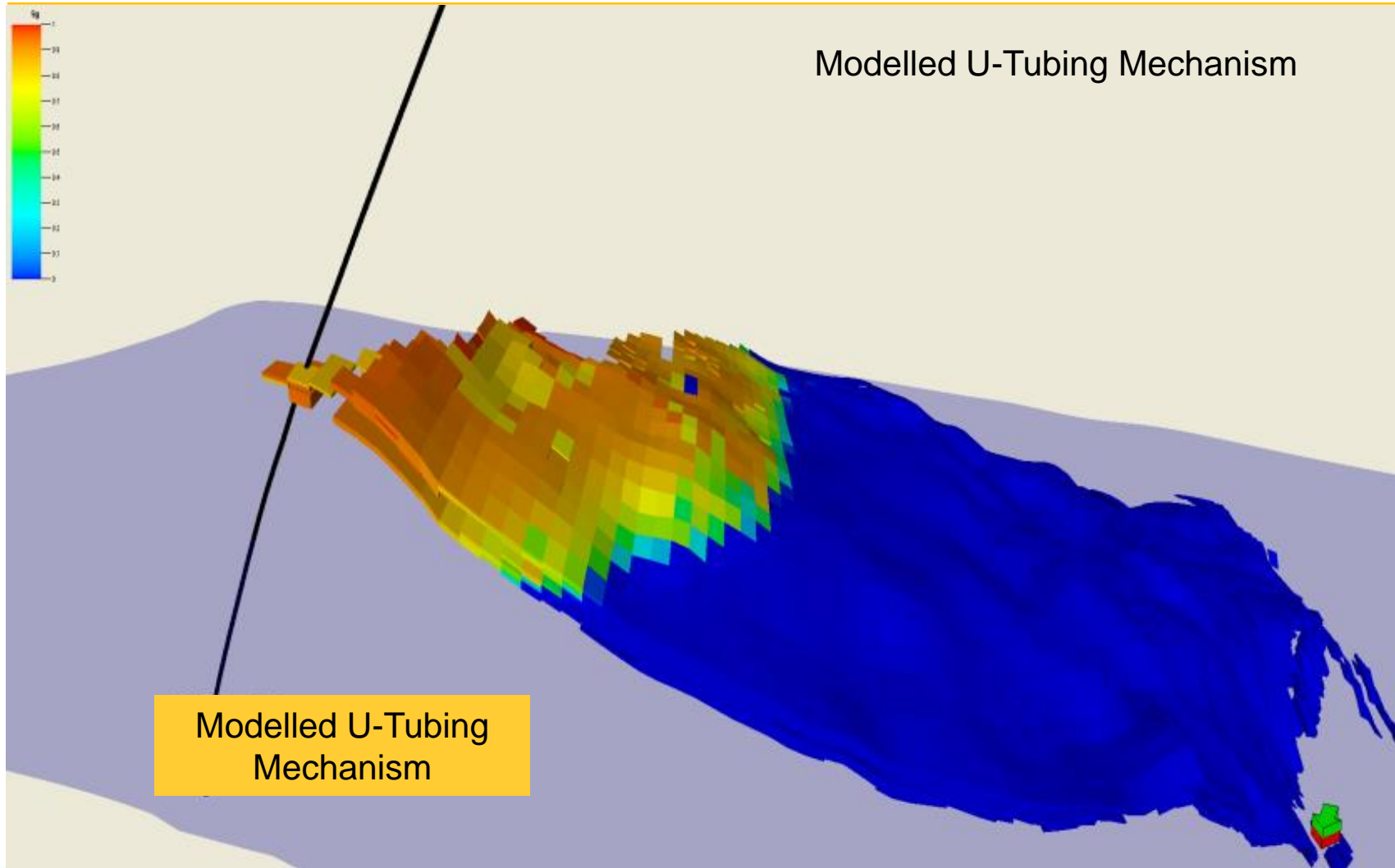
■ Issues

- Production ceased end 2009 with 50% RF from 3 wells
- Water breakthrough not understood – active aquifer not mapable
- Few analogs
- Salt precipitation in wells and reservoir major problem
- Use of long (sub) horizontal wells with multiple layer completions
 - Cross-flow issues between zones
 - Water washes from surface ineffective
- Minimum facilities platform – no coil tubing access

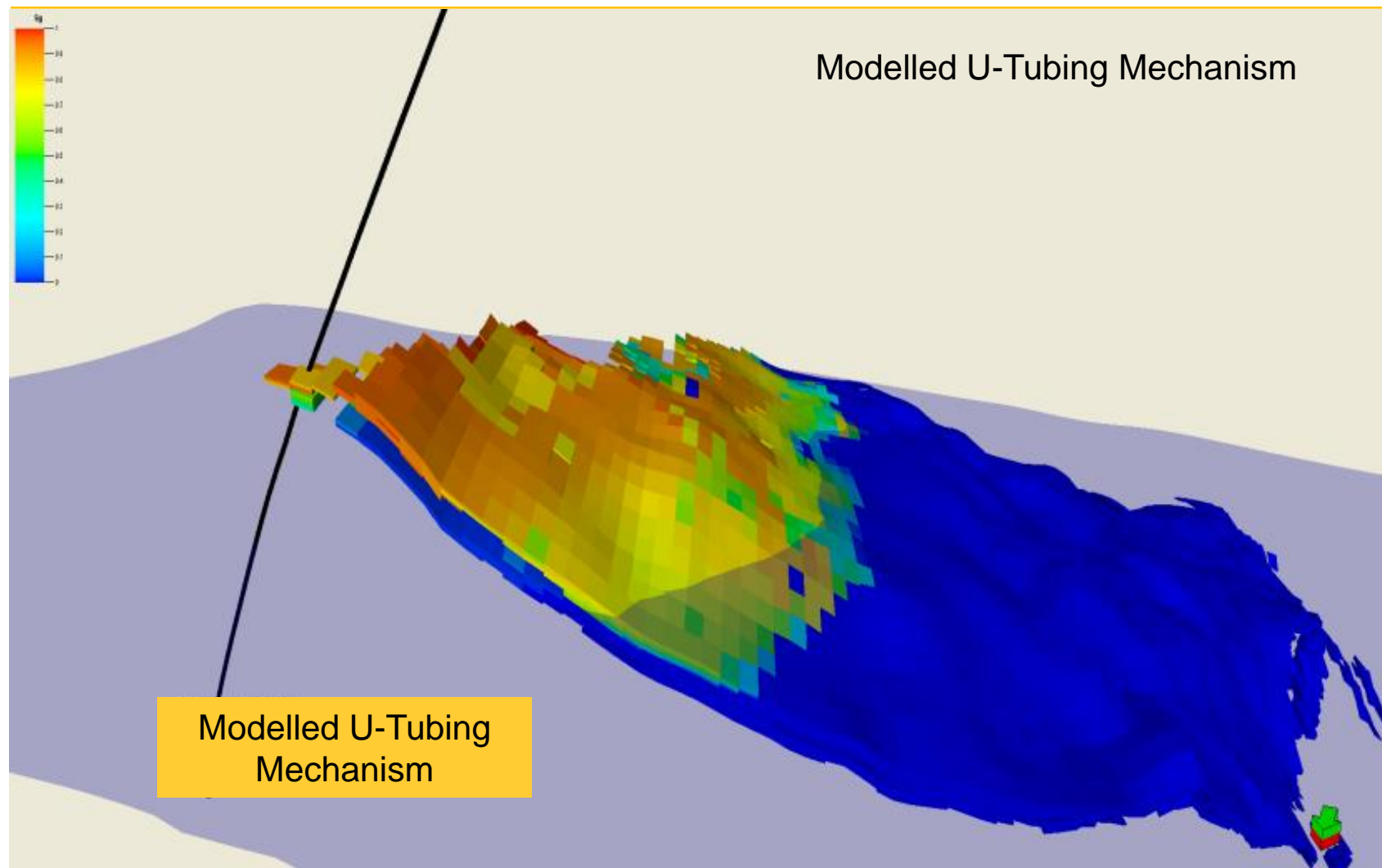
■ Field re-development Challenges

- Understanding – Development cost – Reservoir management

2. Tech. Excellence – Carboniferous Gas

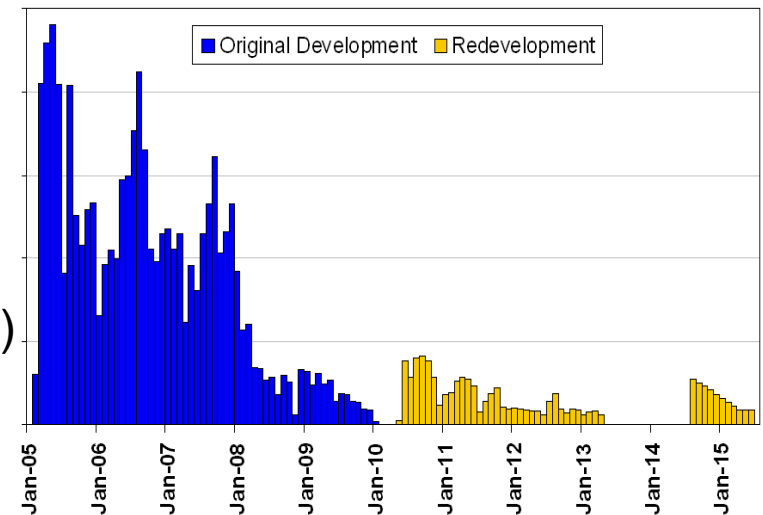


2. Tech. Excellence – Carboniferous Gas



2. Tech. Excellence – Carboniferous Gas

- **Sidetrack well #1** - 950 m horizontal section with 250 bar dP
- **Insert liner well #2** - Cure annular x-flow by salt precipitation vs cement
- **Plug well #3** - Stop water x-flow into gas zone due to u-tube effect
- **Well management**
 - Change to single zone completion strategy
 - Re-perforation & plug setting on tractors
 - Well clean-out using frac boat
- **Results**
 - “U-tube” sand drilled as predicted
 - RF increase from 50% to 60% (predicted)
 - Field life extended by some 6 years



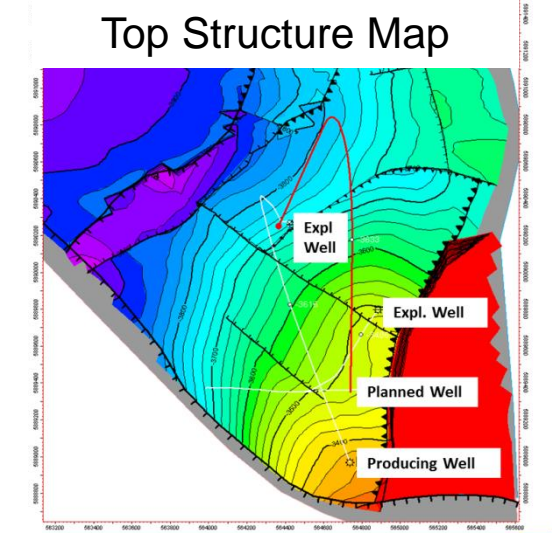
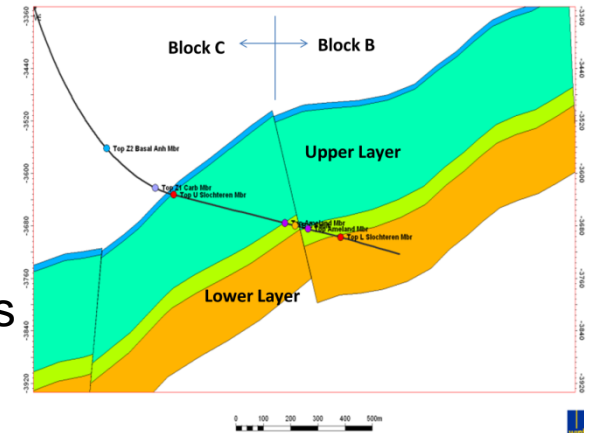
3. Integration – Rotliegend Tight Gas

- **Poor understanding of field performance**
- **High geological uncertainty**
 - Gas-in-place
 - Areal property distribution – large performance range of existing wells
 - Possible compartments lateral & vertical
- **Location within military exercise area**
 - Subsea development
 - Limited window for drilling access
 - PLTs not viable – origin of production unknown
- **Low predicted recovery factor with current wells of some 45%**
- **Field Development Challenges**
 - Understanding – Increasing RF – Managing risk

3. Integration – Rotliegend Tight Gas

- **Fully integrated study undertaken**
 - Range of history matches possible
 - Infill target depends on history match case
 - Horizontal wells not viable (drilling window)
- Procedure made with MoD for concurrent operations
- Planned multi-fraced horizontal infill well
 - Novel trajectory addresses geological uncertainty
 - Max. chance of encountering undepleted gas
 - Max. information for future field development
 - Max. infill well reserves and project value
 - Predicted field RF increase from 45% to 55%

X-Section along Well Trajectory



4. Technology – Salt Precipitation

■ Salt precipitation blocking production

- Precipitation in wells
- Precipitation in reservoir
- More than 50% of WINZ production affected

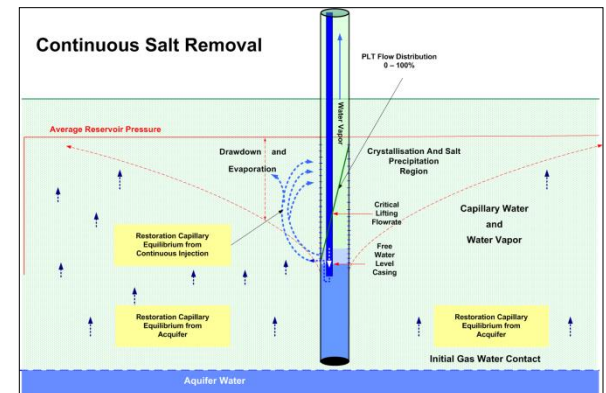
■ Technology Project

- Downhole water injection through cap coil
- Novel fabrication/material requirements
- Pilot project executed successfully
 - “Washes” reservoir & well during production
 - Avoids downtime associated with water injection from surface (6 hours per 2 days)
- Special simulation model developed - results support precipitation in near well bore region

Well at 4.1 km Depth

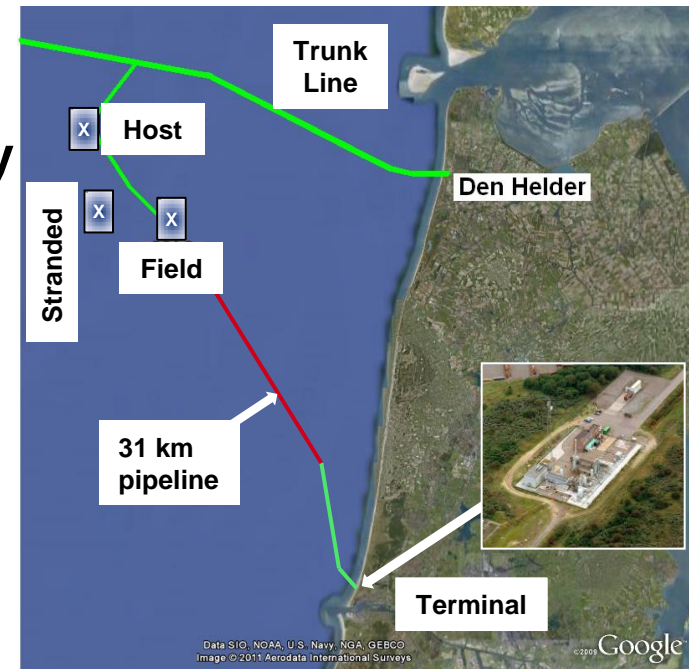


Downhole Salt Removal



5. Commercial – Bunter Gas

- **Unexpected water breakthrough 2009**
- **Rapid decline in production**
- **Host export system (high capacity) costly**
- **Integrated modelling study undertaken**
 - Residual gas in aquifer possible cause
 - Decline to continue with long tail-end period
 - Tail-end production non-economic
 - Re-route to low cost terminal highly attractive
- **Commercial arrangement required**
- **Re-route project executed in 2012**
 - Extended economic field life by 6 years
 - Stranded discovery developed 2014



Infrastructure
— Existing — New

6. Vision – Rotliegend Gas Cluster

■ Very mature asset in harvest mode

- 3 fields with process/compression platform
- In harvest mode with end of field life 2012

■ Vision: 5-10 years asset life extension

- Opportunity portfolio developed covering full activity range: exploration to facility mods

■ Status

- Re-routing production and converting facility to satellite (opex & fuel gas saving) – done
- Upgrading new host to 3 bar suction – done
- Fracking of non-producing well – done
- Development of stranded gas field – study ongoing
- Field life extended to 2016 (2020 with new field)



Process/Compression Platform
Now Satellite

Results

■ Organisation

- Production Optimisation Department grown to 25 skilled people
- Focus of Department and WINZ organisation on production optimisation
- Developed reservoir management models & plans for all key reservoirs

■ Significant impact on the WINZ business

- Executed some 40 projects & several new technologies developed
- Projects to date added some 4 Bcm reserves & € 0.3 Bln value (post tax)
- Economic field life extended by some 2 to 7 years for all main platforms
- Projects largely on time and budget, results in line with expectations

■ WINZ production decline turned around to an increasing trend

- Production optimisation significant contributor to business performance
- Ca 60% of annual proven reserve additions from Production Optimisation

Summary



■ Production Optimisation

- Can be highly attractive
- Relatively low Capex exposure
- Relatively low risk due to calibration through production performance

■ Requires

- Dedicated effort
- Integration of all disciplines
- Making resources available
- High degree of innovation